



MODULATE: ANR project for the modeling of long period ground motions and the assessment of their effects on large-scale infrastructures

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modulate.brgm.fr

Overview

MODULATE is a research project co-financed by the French National Research Agency, and coordinated by the Bureau de Recherches Géologiques et Minières (BRGM).

The project aims at developing a physical model for surface waves based on a systematic analysis of strong ground motion recorded on the floor of sedimentary basins using evolutionary stochastic processes. The model will then be superimposed to standard simulations of body waves for the performance-based reliability assessment of large-scale structures, with emphasis on the effects of resonance and exposure to excitation of longer duration.

Context

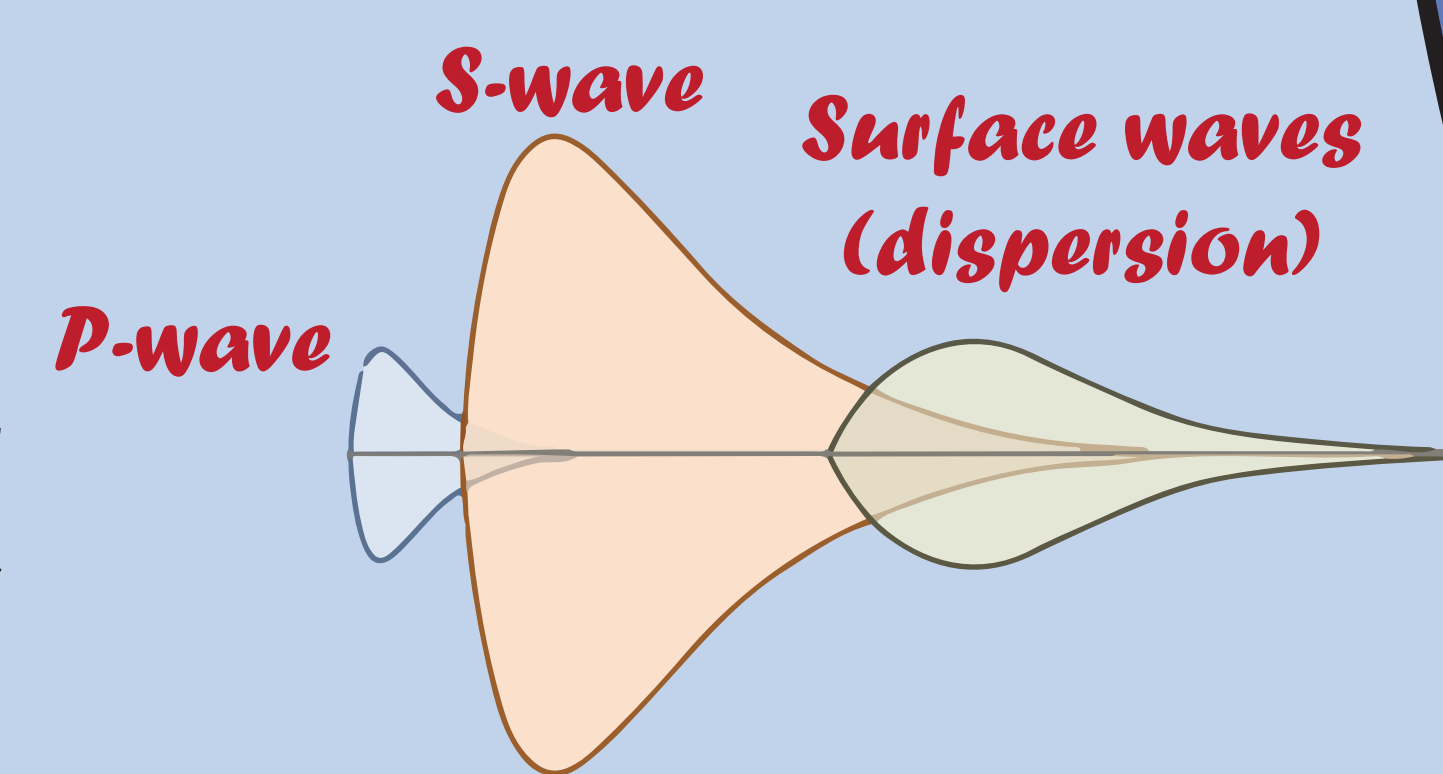
The project is focused on large-scale structures, which include among others: high-rise buildings, large fluid storage tanks and long-span suspension bridges.



The importance of long period motions on the response of large-scale structures has been well recognized by the earthquake engineering community.

However, because such long period motions are usually associated with surface waves, their incorporation in analysis procedures was never

systematically performed. Part of the problem has been the fact that surface waves are described by more complicated characteristics (e.g. dispersion) that may not be well understood widely among earthquake engineers.



Objectives

- Study of surface waves characteristics: dispersion, non-stationarity, duration...
- Development of a stochastic model for long-period ground motion linked to the physical parameters of sedimentary basins and the seismic input.
- Implementation of the stochastic model to generate synthetic broadband ground motion.
- Evaluation of the seismic performance of large-scale infrastructures subjected to the generated ground motion.

Expected impact

With an evolutionary stochastic model we will provide a complete and expedient, yet realistic, description of strong ground motion on sedimentary basins. The stochastic description of ground motion will in turn provide the means for realistic practical assessment of the reliability of critical large infrastructures.

The project findings are expected:

- to influence code development committees,
- to provide engineers with tools for seismic design,
- to contribute to the safety of large-scale infrastructures.

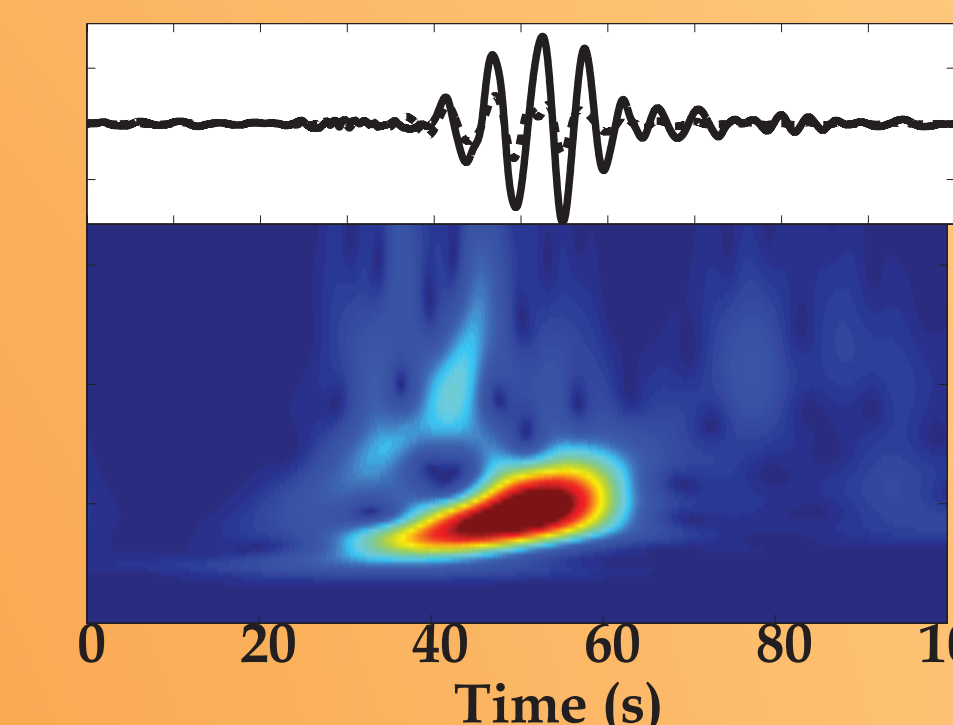
Characterization and modeling of long period ground motion

Compilation of an extensive database of strong motion data recorded on sedimentary basins will allow the development of the stochastic model.

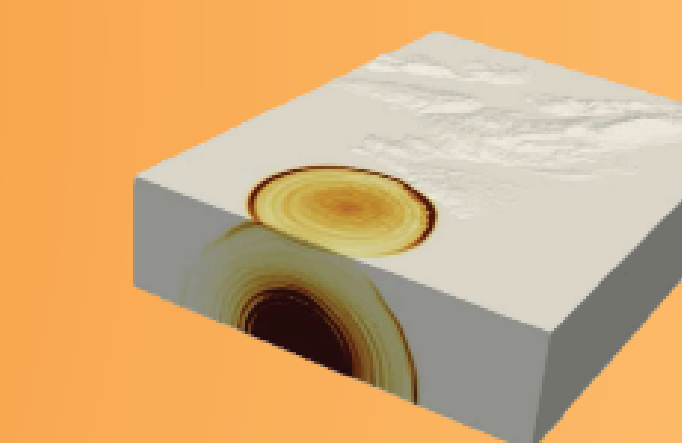
A key element to study the characteristics of surface waves is the ability to **identify** and **extract** them from a strong motion record.

Given certain physical basin characteristics and a potential earthquake, the envisioned model will provide, :

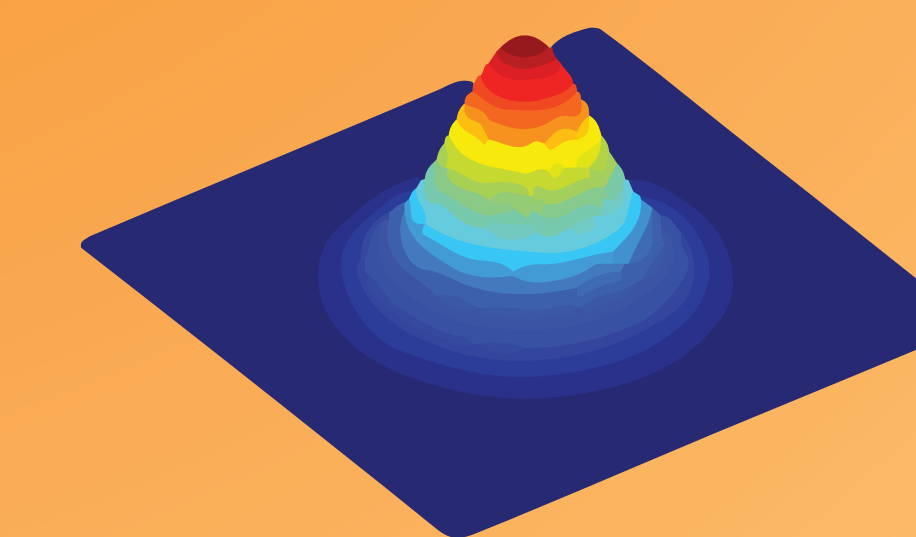
- the amplification function of the spectral amplitudes at long periods,
- the evolutionary power spectral density function for the stochastic description of the ground motion.



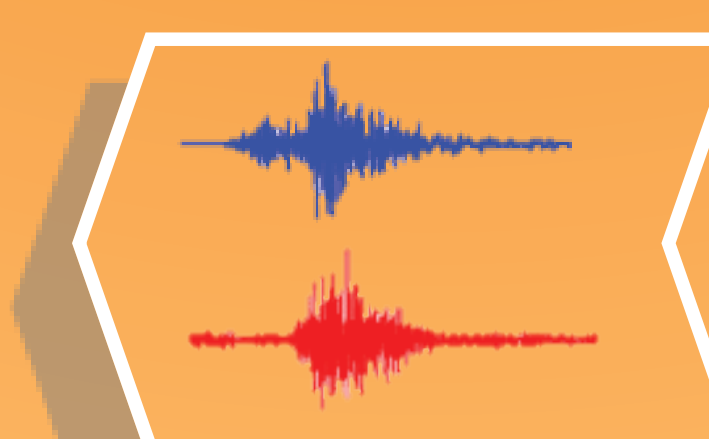
Surface wave
Extraction



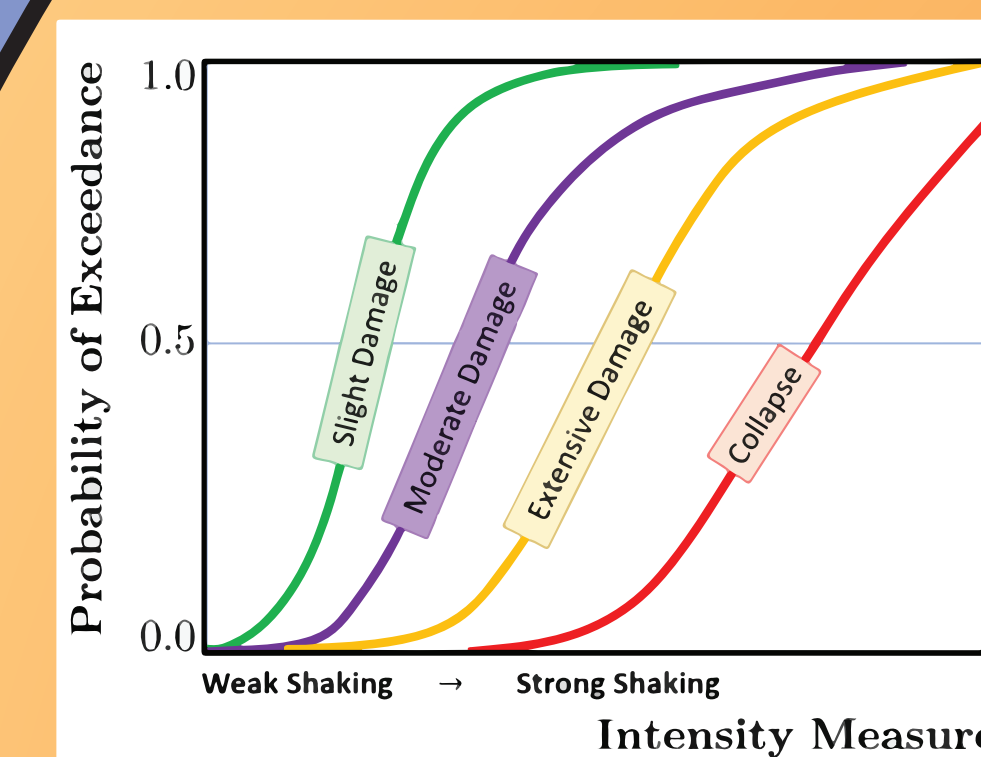
3D Simulations at
specific sites



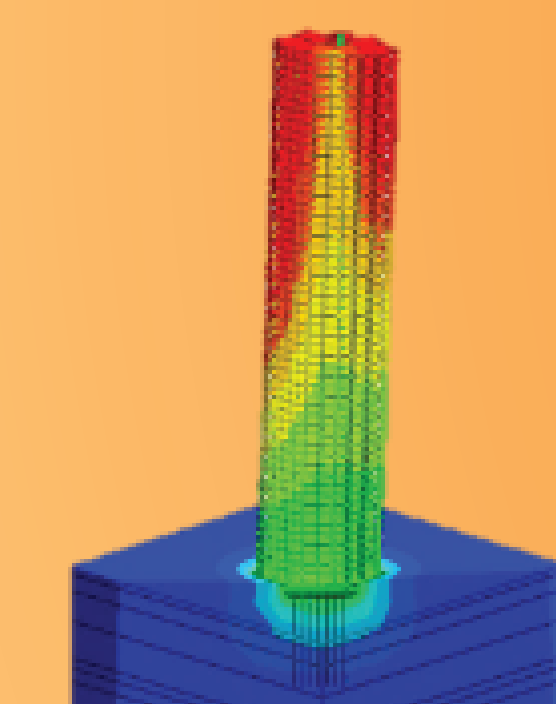
Stochastic
Modeling



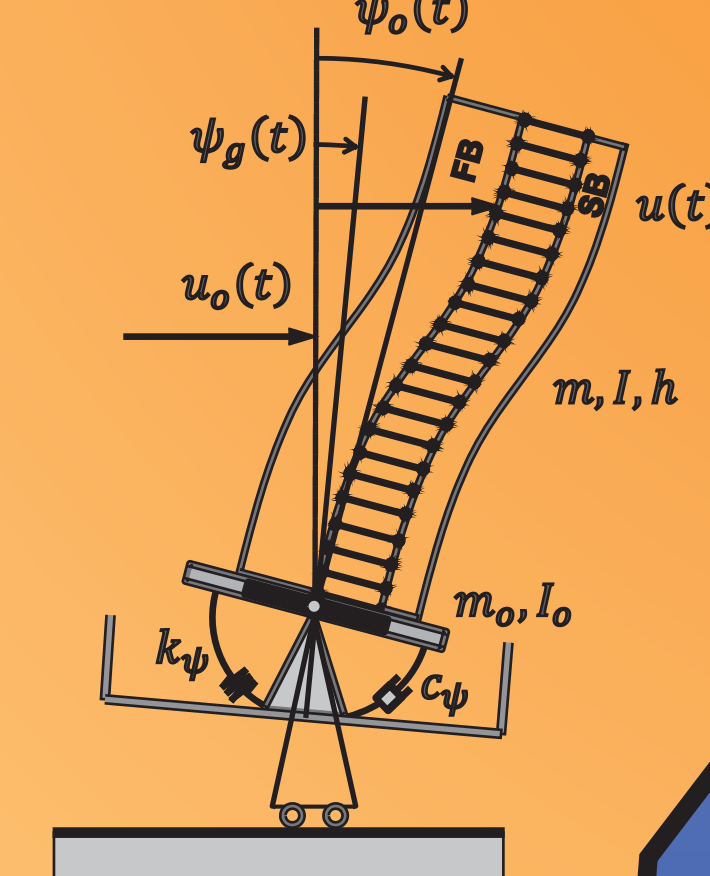
Simulated &
recorded
time histories



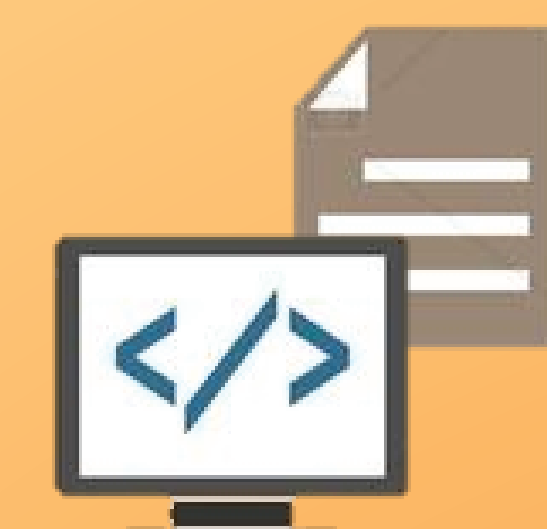
Vulnerability
Assessment



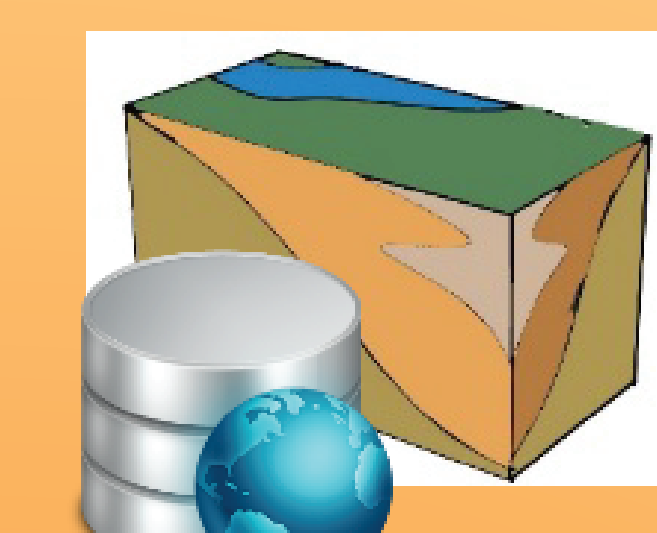
Response-
3D SSI
models



Response-
Surrogate
models



Tools &
Recommendations



Database
Compilation

Scientific program

Consortium

